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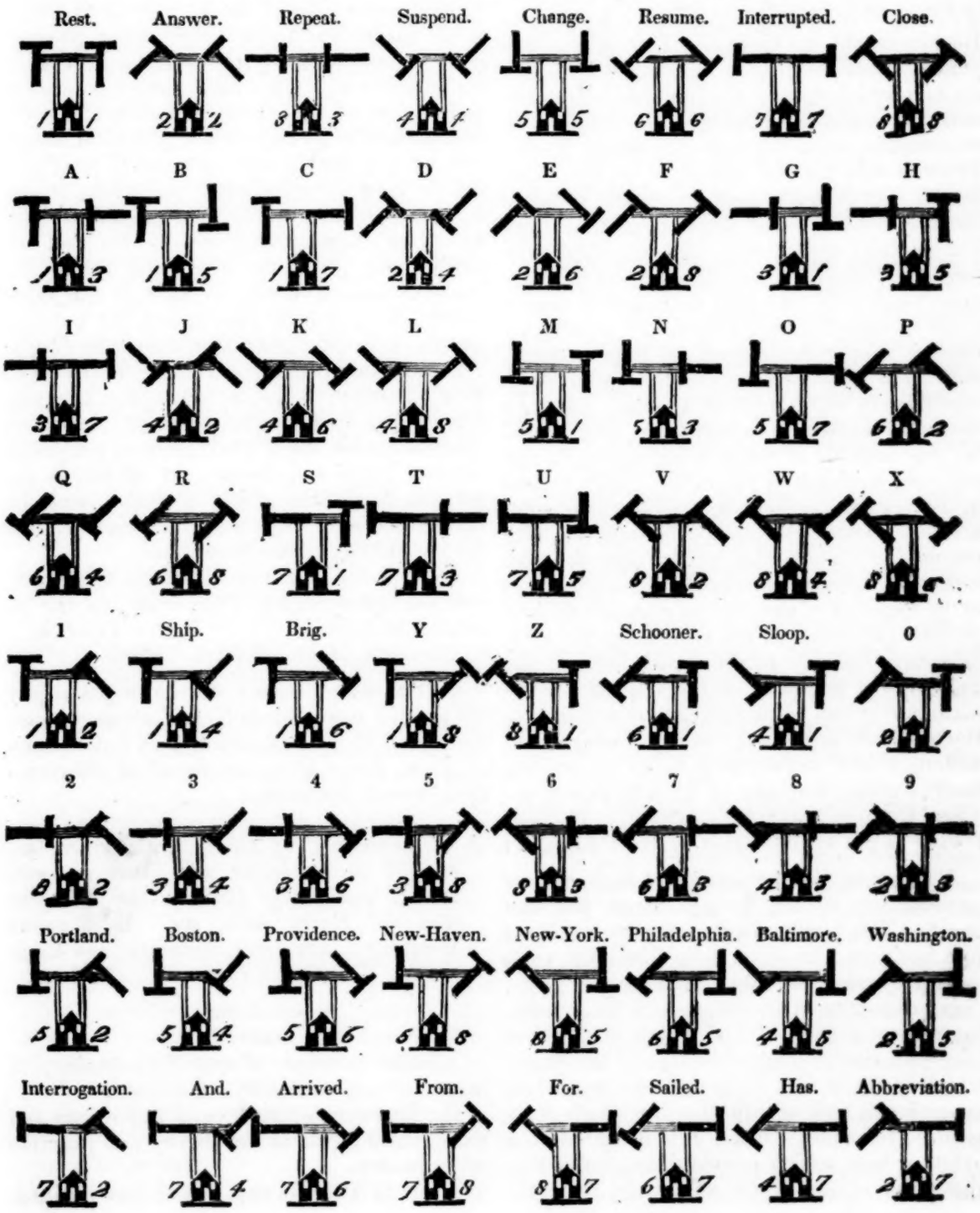
"Men are often capable of greater things than they perform: they are sent into the world with bills of credit, and seldom draw to their full extent."—HORACE WALPOLE.

SCALE OF SIGNALS OF PORTER'S IMPROVED TELEGRAPH.



Improved Telegraph.

To the Editor of the Mechanics' Magazine :

Sir,—I have for several years had on hand a model and set of drawings of an improved telegraph, calculated for inland communication, and by the use of which any piece of information which may be expressed by one hundred alphabetic letters may be conveyed from New-York to Boston in sixteen minutes. I have hitherto, on account of a press of other business, neglected to submit my plans either to the public, or to such individuals as would be likely to take an interest in the improvement. The number of stations requisite to constitute a line from New-York to Boston would be twelve. The whole expense of establishing a line will not exceed six hundred dollars. The expense of attendance is estimated at twelve dollars a day. A reasonable price for communicating intelligence would be one cent per letter. Ten letters per minute may be passed through the line, which would amount to more than sixty dollars a day when the telegraph was kept employed. I make these statements to encourage any one who may find it convenient to establish such a line, and to whom I should tender the use of my improvement, with such assistance as I could render, for a small share of the profit thereof. Among the employers of a telegraphic line would be the masters of vessels belonging to one port and arriving at the other. The arrival of all regular packets, and all the important arrivals from foreign ports, would be telegraphed at the expense of the owners; and items of important foreign or domestic news at the expense of the editors who should first publish the same in the places where such information should be received by telegraph; drawings of lotteries, at the expense of the managers; and even individuals arriving at Boston from New-York (or vice versa) would willingly pay twenty-five cents to inform their anxious families or friends, in ten minutes' time, of their safe arrival. The following is the specification of the telegraph:

Two posts, about sixteen feet high, are set permanently in the ground about five feet apart. The heads of the posts are tennoned to a horizontal beam sixteen feet long, each end projecting six feet beyond the posts. Near each end of the beam is a T, consisting of two planks, one of which is ten feet long and sixteen inches wide; and the other, which is seven feet long and two feet wide, crosses one end of the first, to which it is secured by nails. Each T is mounted on a pivot, or bolt, which passes through the T at the point of its centre of gravity; to the centre of the T is also attached a wheel, two inches thick and two feet in diameter; so that the pivot-bolt passes through both the T and wheel into the side of the beam. Between the two posts is a *watch-box*, (or shelter for the signalist,) in the middle of which is a post or vertical plant six inches wide, from each edge of which eight small hooks or pins project, being nine inches apart. Each row of hooks is numbered from the top downward, from one to eight inclusive. The first hook sustains a ring, from which a rope extends upward to the beam, where it passes over a small pulley; thence horizontally to the upper side of the T wheel, to which it is made fast by a staple, after passing once round, (the wheel having a groove in its periphery.) The rope thence continues over a part of the wheel, and from the lower side horizontally to another pulley on one of the main posts; thence downward nearly to the bottom of the watch-box, inside, where it is attached to a fourteen pound weight, which is thereby suspended. By this arrangement, it will be seen, that when the ring is hauled down to any of the other hooks, the weight is raised, and the position of the T is changed; and when the ring is returned, the weight returns the T also to its first position. Thus, by changing the places of the two rings, on their respective rows of hooks, the T's will present sixty-four distinct positions, twenty-six of which represent the letters of the alphabet, and the remainder have each a signification suitable for facilitating communications.

I claim the construction of the telegraph, and the arrangement of the scale, as far as above specified. Rufus Porter.

Billerica, Mass., Sept. 2, 1834.

Note.—The leader of the signals may frequently avail himself of abbreviations, such as S B for steamboat, C N for communication, &c. adding the signal of abbreviation in each instance.

A Compendium of Civil Architecture, arranged in Questions and Answers, with Notes, embracing History, the Classics, and the Early Arts, &c. By Robert Brindley, Architect, Surveyor, and Engineer. [Continued from page 170.]

GEOMETRY.

Q. What is geometry?

A. The science of quantity, quality, or magnitude, abstractedly considered.

Q. Enumerate the several definitions and axioms laid down in the theory and practice of geometry.

A. 1. A Point is that which has position,

but no magnitude nor dimensions; neither length, breadth, nor thickness.

2. A Line is length, without breadth, or thickness.

3. A Surface or Superficies is an extension, or a figure of two dimensions, length and breadth, but without thickness.

4. A Body or Solid is a figure of three dimensions, namely, length, breadth, and depth, or thickness.

5. Lines are either Right or Curved, or Mixed of these two.

6. A Right Line, or Straight Line, lies all in the same direction between its extremities, and is the shortest distance between two points.

When a line is mentioned simply, it means a right line.

7. A Curve continually changes its direction between its extreme points.

8. Lines are either Parallel, Oblique, Perpendicular, or Tangential.

9. Parallel Lines are always at the same perpendicular distance; and they never meet, though ever so far produced.

10. Oblique Lines change their distance, and would meet if produced on the side of the least distance.

11. One line is perpendicular to another, when it inclines not more on one side than the other, or when the angles on both sides of it are equal.

12. A line or circle is Tangential, or is a Tangent to a circle, or other curve, when it touches it, without cutting, although both are produced.

13. An Angle is the inclination or opening of two lines, having different directions, and meeting in a point.

14. Angles are Right or Oblique, Acute or Obtuse.

15. A Right Angle is that which is made by one line perpendicular to another, or when the angles on each side are equal to one another they are right angles.

16. An Oblique Angle is that which is made by two oblique lines, and is either less or greater than a right angle.

17. An Acute Angle is less than a right angle.

18. An Obtuse Angle is greater than a right angle.

19. Superficies are either Curved or Plane.

20. A Plane Superficies, or a Plane, is that with which a right line may every way coincide.. Or if the line touch the plane in two points, it will touch it in every point; but if not, it is curved.

21. Plane Figures are bounded either by right lines or curves.

22. Plane figures that are bounded by right lines have names according to the number of their sides, or of their angles; for they have as many sides as angles, the least number being three.

23. A figure of three sides and angles is called a Triangle; and it receives particular denominations from the relations of its sides and angles.

24. An Equilateral Triangle is that whose three sides are all equal.

25. An Isosceles Triangle is that which has two sides equal.

26. A Scalene Triangle is that whose three sides are all unequal.

27. A Right-angled Triangle is that which has one right angle.

28. Other triangles are oblique angled, and are either obtuse or acute.

29. An Obtuse-angled Triangle has one obtuse angle.

30. An Acute-angled Triangle has all its three angles acute.

31. A figure of four sides and angles is called a Quadrangle, or a Quadrilateral.

32. A Parallelogram is a quadrilateral which has both its pairs of opposite sides parallel; and it takes the following particular names, viz. Rectangle, Square, Rhombus, Rhomboid.

33. A Rectangle is a parallelogram having a right angle.

34. A square is an equilateral rectangle, having its length and breadth equal, or all its sides equal, and all its angles equal.

35. A Rhomboid is an oblique-angled parallelogram.

36. A Rhombus is an equilateral rhomboid, having all its sides equal, but its angles oblique.

37. A Trapezium is a quadrilateral which hath not its opposite sides parallel.

38. A Trapezoid has only one pair of opposite sides parallel.

39. A Diagonal is a line joining any two opposite angles of a quadrilateral.

40. Plane figures that have more than four sides are in general called Polygons: and they receive other particular names, according to the number of their sides or angles. Thus—

41. A Pentagon is a polygon of five sides; a Hexagon, of six sides; a Heptagon, seven; an Octagon, eight; a Nonagon, nine; a Decagon, ten; an Undecagon, eleven; and a Dodecagon, twelve sides.

42. A Regular Polygon has all its sides and all its angles equal. If they are not both equal, the polygon is Irregular.

43. An Equilateral Triangle is also a Regular Figure of three sides, and the Square

is one of four: the former being also called a Trigon, and the latter a Tetragon.

44. Any figure is equilateral when all its sides are equal: and it is equi-angular when all its angles are equal. When both these are equal, it is a regular figure.

45. A Circle is a plane figure bounded by a curve line called the Circumference, which is every where equidistant from a certain point within called its Centre.

The circumference itself is often called a circle, and also the Periphery.

46. The Radius of a circle is a line drawn from the centre to the circumference.

47. The Diameter of a circle is a line drawn through the centre, and terminating at the circumference on both sides.

48. An Arc of a circle is any part of the circumference.

49. A Chord is a right line joining the extremities of an arc.

50. A Segment is any part of a circle bounded by an arc and its chord.

51. A Semi-circle is half the circle, or a segment cut off by a diameter.

The half circumference is sometimes called the Semi-circle.

52. A Sector is any part of a circle which is bounded by an arc, and two radii drawn to its extremities.

53. A Quadrant, or Quarter of a circle, is a Sector having a quarter of the circumference for its arc, and its two radii are perpendicular to each other. A quarter of the circumference is sometimes called a Quadrant.

54. The Height or Altitude of a figure is a perpendicular let fall from an angle, or its vertex, to the opposite side called the base.

55. In a right-angled triangle, the side opposite the right angle is called the Hypothenuse, and the other two sides are called the Legs, and sometimes the Base and Perpendicular.

56. When an angle is denoted by three letters, of which one stands at the angular point, and the other two on the two sides, that which stands at the angular point is read in the middle.

57. The circumference of every circle is supposed to be divided into 360 equal parts, called Degrees, and each Degree into 60 Minutes, each Minute into 60 Seconds, and so on. Hence, a semi-circle contains 180 degrees, and a quadrant 90 degrees.

58. The Measure of an angle is an arc of any circle contained between the two lines which form that angle, the angular point being the centre; and it is estimated by the number of degrees contained in that arc.

59. Lines or chords are said to be Equidistant from the centre of a circle, when perpendiculars drawn to them from the centre are equal.

60. And the right line on which the Greater Perpendicular falls is said to be farther from the centre.

61. An Angle In a segment is that which is contained by two lines, drawn from any point in the arc of the segment to the two extremities of that arc.

62. An Angle On a Segment, or an arc, is that which is contained by two lines, drawn from any point in the opposite or supplemental part of the circumference, to the extremities of the arc, and containing the arc between them.

63. An Angle, at the circumference, is that whose angular point is any where in the circumference. And an angle at the centre is that whose angular point is at the centre.

64. A right-lined figure is Inscribed in a circle, or the circle Circumscribes it, when all the angular points of the figure are in the circumference of the circle.

65. A right-lined figure Circumscribes a circle, or the circle is Inscribed in it, when all the sides of the figure touch the circumference of the circle.

66. One right-lined figure is Inscribed in another, or the latter circumscribes the former, when all the angular points of the former are placed in the sides of the latter.

67. A Secant is a line that cuts a circle, lying partly within and partly without it.

68. Two triangles, or other right-lined figures, are said to be mutually equilateral, when all the sides of the one are equal to the corresponding sides of the other, each to each; and they are said to be mutually equiangular when the angles of the one are respectively equal to those of the other.

69. Identical figures are such as are both mutually equilateral and equiangular, or that have all the sides and all the angles of the one respectively equal to all the sides and all the angles of the other, each to each; so that if the one figure were applied to, or laid upon the other, all the sides of the one would exactly fall upon and cover all the sides of the other; the two becoming as it were but one and the same figure.

70. Similar figures are those that have all the angles of the one equal to all the angles of the other, each to each, and the sides about the equal angles proportional.

71. The Perimeter of a figure is the sum of all its sides taken together.

72. A Proposition is something which is either proposed to be done or to be demonstrated, and is either a problem or a theorem.

73. A Problem is something proposed to be done.

74. A Theorem is something proposed to be demonstrated.

75. A Lemma is something which is premised or demonstrated, in order to render what follows more easy.

76. A Corollary is a consequent truth, gained immediately from some preceding truth or demonstration.

77. A Scholium is a remark or observation made upon something going before it.

AXIOMS.

1. Things which are equal to the same thing are equal to each other.

2. When equals are added to equals, the wholes are equal.

3. When equals are taken from equals, the remainders are equal.

4. When equals are added to unequals, the wholes are unequal.

5. When equals are taken from unequals, the remainders are unequal.

6. Things which are double of the same thing, or equal things, are equal to each other.

7. Things which are halves of the same thing are equal.

8. Every whole is equal to all its parts taken together.

9. Things which coincide, or fill the same space, are identical, or mutually equal in all their parts.

10. All right angles are equal to one another.

11. Angles that have equal measures, or arcs, are equal.

RATIOS AND PROPORTIONS.

1. Ratio is the proportion or relation which one magnitude bears to another magnitude of the same kind, with respect to quantity.

Note—The measure or quantity of a ratio is conceived, by considering what part or parts the leading quantity, called the Antecedent, is of the other, called the Consequent; or what part or parts the number expressing the quantity of the former is of the number denoting, in like manner, the latter. So the ratio of a quantity expressed by the number 2, to a like quantity expressed by the number 6, is denoted by 2 divided by 6, or three sixths, or one third: the number 2 being 3 times contained in 6, or the third part of it. In like manner, the ratio of the quantity 3 to 6 is measured by three sixths, or one half; the ratio of 4 to 6 is four sixths, or two thirds; that of 6 to 4 is six fourths, or three halves, &c.

2. Proportion is an equality of ratios. Thus—

3. Three quantities are said to be proportional, when the ratio of the first to the second is equal to the ratio of the second to the third. As of the three quantities A (2), A (4), C (8), where two fourths are equal to four eighths, and one half, both the same ratio.

4. Four quantities are said to be proportional, when the ratio of the first to the second is the same as the ratio of the third to the fourth. As of the four, A (4), B (2), C (10), D (5), where four halves are equal to ten fifths and 2, both the same ratio.

Note—To denote that four quantities, A, B, C, D, are proportional, they are usually stated or placed thus, A : B : : C : D; and read thus, A is to B as C is to D. But when three quantities are proportional, the middle one is repeated, and they are written thus, A : B : : B : C.

The proportionality of quantities may also be expressed very generally by the equality of fractions. Thus, if $\frac{A}{B} = \frac{C}{D}$, then A : B : : C : D, also B : A : : C : D, and A : C : : B : D, and C : A : : B : D.

5. Of three proportional quantities, the middle one is said to be a Mean Proportional between the other two; and the last, a Third Proportional to the first and second.

6. Of four proportional quantities, the last is said to be a Fourth Proportional to the other three, taken in order.

7. Quantities are said to be Continually Proportional, or in Continued Proportion, when the ratio is the same between every two adjacent terms, namely, when the first is to the second as the second to the third, as the third to the fourth, as the fourth to the fifth, and so on, all in the common ratio.

As in the quantities 1, 2, 4, 8, 16, &c. where the common ratio is equal to 2.

8. Of any number of quantities, A, B, C, D, the ratio of the first, A, to the last, D, is said to be Compounded of the ratios of the first to the second, of the second to the third, and so on to the last.

9. Inverse ratio is when the antecedent is made the consequent, and the consequent the antecedent. Thus, if 1 : 2 : : 3 : 6, then, inversely, 2 : 1 : : 6 : 3.

10. Alternate proportion is when antecedent is compared with antecedent, and consequent with consequent, as, if 1 : 2 : : 3 : 6, then, by alternation, or permutation, it will be 1 : 3 : : 2 : 6.

11. Compound ratio is when the sum of the antecedent and consequent is compared, either with the consequent or with the antecedent. Thus, if 1 : 2 : : 3 : 6, then, by

composition, 1 plus 2 : : 3 plus 6 : 3, and 1 plus 2 : 2 : : 3 plus 6 : 6.

12. Divided ratio is when the difference of the antecedent and consequent is compared, either with the antecedent or with the consequent. Thus, if 1 : 2 : : 3 : 6, then, by division, 2—1 : 1 : : 6—3 : 3, and 2—1 : 2 : : 6—3 : 6.

Note—The term Divided, or Division, here means subtracting or parting; being used in the sense opposed to compounding or adding, in def. 11.

PLANES AND SOLIDS.

1. The Common Section of two Planes is the line in which they meet or cut each other.

2. A Line is Perpendicular to a Plane, when it is perpendicular to every line in that plane which meets it.

3. One Plane is Perpendicular to another, when every line of the one which is perpendicular to the line of their common section is perpendicular to the other.

4. The Inclination of one Plane to another, or the angle they form between them, is the angle contained by two lines drawn from any point in the common section, and at right angles to the same, one of these lines in each plane.

5. Parallel Planes are such as, being produced ever so far both ways, will never meet, or which are every where at an equal perpendicular distance.

6. A Solid Angle is that which is made by three or more plane angles meeting each other in the same point.

7. Similar Solids contained by plane figures are such as have all their solid angles equal, each to each, and are bounded by the same number of similar planes alike placed.

8. A Prism is a solid whose ends are parallel, equal, and like plane figures, and its sides connecting those ends are parallelograms.

9. A Prism takes particular names, according to the figure of its base or ends, whether triangular, square, rectangular, pentagonal, hexagonal, &c.

10. A Right or Upright Prism is that which has the planes of the sides perpendicular to the planes of the ends or base.

11. A Parallelopiped, or Parallelopipedon, is a prism bounded by six parallelograms, every opposite two of which are equal, alike, and parallel.

12. A Rectangular Parallelopipedon is that whose bounding planes are all rectangles, which are perpendicular to each other.

13. A Cube is a square prism, being bounded by six equal square sides or faces, which are perpendicular to each other.

14. A Cylinder is a round prism, having circles for its ends; and is conceived to be formed by the rotation of a right line about the circumferences of two equal and parallel circles, already parallel to the axis.

15. The Axis of a Cylinder is the right line joining the centres of the two parallel circles about which the figure is described.

16. A Pyramid is a solid, whose base is any right lined plane figure, and its sides triangles, having all their vertices meeting together in a point above the base, called the vertex of the pyramid.

17. A Pyramid, like the prism, takes particular names from the figure of the base.

18. A Cone is a round pyramid, having a circular base; and is conceived to be generated by the rotation of a right line about the circumference of a circle, one end of which is fixed at a point above the plane of that circle.

19. The Axis of a Cone is the right line joining the vertex or fixed point, and the centre of the circle about which the figure is described.

20. Similar Cones and Cylinders are such as have their altitudes and the diameters of their bases proportional.

21. A Sphere is a solid bounded by one curve surface, which is every where equally distant from a certain point within, called the Centre. It is conceived to be generated by the rotation of a semi-circle about its diameter, which remains fixed.

22. The Axis of a Sphere is the right line about which the semi-circle revolves; and the centre is the same as that of the revolving semi-circle.

23. The Diameter of a Sphere is any right line passing through the centre, and terminated both ways by the surface.

24. The Altitude of a Solid is the perpendicular drawn from the vertex to the opposite side or base.

On the Comparative Value and Importance of Mathematical Science, and on the Pretensions of its Professors. [From the London Mechanics' Magazine.]

(Continued from page 186.)

Let us take other views of mathematicians and practical men bending their faculties towards the attainment of the same object. The most valuable method of determining the longitude was at last accomplished through practical means, and by practical men. Euler aimed to produce an achromatic lens as well as Dolland, but it was the latter who succeeded; and their respective modes of proceeding mark both the

character and comparative value of their efforts. As to the steam engine, science (other than the most common) cannot lay a particle of claim to it. It is the all-important gift to the world from practical men alone. One was a miner, another was a blacksmith, a third was a glazier, and a fourth a watchmaker. Science has not even now elucidated all its principles,—one important point is as obscure at the present day as ever it was. During the time this mighty engine was maturing, and having for its ultimate effect a political, a moral, and a social revolution throughout the whole earth, the mathematicians of the foreign academies, the Eulers, and the Bernouilles, even when engaged on physico-mathematical subjects, were exciting each other's ingenuity, and eliciting their mutual admiration, by very profound but very sterile inquiries into things selected purposely and merely for the opportunity they afforded for the most abstruse and difficult investigations. Such was that concerning the gyratory motion of a body fastened to an *extensible* thread, first in a horizontal plane, and then, for the sake of the choice piece of complication produced by the introduction of the force of gravity, in a vertical plane, but ending at last with a suspicion that all was wrong. Such was that on the formulæ for determining the motion of a thread perfectly flexible, ending in unmanageable equations. And such was that concerning tractory and compound tractory curves, formed by a weight in one case, and two or more weights in the other, being moved by a thread whose end travels along a line either straight or curved, ending also unsatisfactorily. *Your* Magazine, Mr. Editor, is also the theatre occasionally for the display and sharpening of the wits of certain geometrical correspondents. Such was the tendency of the problem lately proposed and solved—"To inscribe a quadrilateral in a given circle, having given each of the diagonals and area." Why should not these have their puzzles as well as the more profound analysts? They form good school-boy exercises, and school-boys accordingly have sustained a conspicuous part on your stage. Some persons are particularly apt at such questions, and so are others at solving riddles. The different manner in which the proposal for an undulating in lieu of a level railway has been received by the *mere* mathematicians on the one hand, and by the body of civil engineers on the other, is also abundantly significant of the comparative rank and importance which the former hold in the scale of intellect and utility. Your correspondents, Kinclaven, Iver Maciver, and M. S., are mathematicians—geometricians, at any rate—and they have sided with Mr. Badnall. Be it so—the impress is of their own stamping, and the currency is their own issue.

The limits to which I am confined will permit me merely to allude, and only, to a few more instances of the unfitness of the mere mathematician for physical inquiries, and of the unsatisfactory applications of their science. At one time the animal economy was mathematically and mechanically explained. The treatises on physiology were filled with problems, long calculations, and algebraic formulæ. Lawrence says, "that one estimated the force of the heart as equal to 180,000 pounds; another reduced it to 8 oz.; and both these conclusions are deduced from reasonings clothed in all the imposing forms of the *exact* sciences."

Even the phenomena of the mind have been forced within the pale of mathematical disquisition. Hartley's elaborate hypothesis of the *vibratory* nature of thought and feeling would afford a choice and subtle theme for analysts of the French school, if only a few facts could be found to give it a coloring of truth, and a plausible pretence for the application of the calculus. We may then hope to find an expression for the velocity of our ideas, with the corrections due to variations in the temperature, moisture, and tension of the medullary fibre!

To come to our own times, there is Sir R. Phillips' theory *of all things*—ingenious enough, but that is all. Then there is Mr. Herepath's mathematico-chemical theory, accompanied with a challenge to the Royal Society, and preposterously backed with an offer to wager £1000 on the issue, in which the molecules of the gases are continually jostling each other and perpetually at loggerheads. The whole scheme is, however, mathematically and demonstrably true, especially if reasoning in a circle be only a circuitous way to truth.* Then there is the more measured movement of the ultimate particles of matter according to the theory of Mr. Emmet, by reason of the altered ratio of the forces which previously held them in equilibrium—the disturbing force being calo-

* This conspicuous herald of his own and Mr. Gurney's fame will surely be satisfied if his theory be as true as his assertion, that Mr. Gurney's steam-drag would transfer the same weight as it does on a common road, "*two hundred and sixty* or *two hundred and eighty* miles per hour on a railway, supposing mechanical laws followed, and that the materials and the resistance of the atmosphere would allow it." A slight mistake this—identical with Kinclaven's, of supposing the expenditure of power not to follow the ratio of the velocity as well as the resistance. This is another instance, by-the-by, on the part of both these persons, (for they are one only in error, I imagine,) of mathematical fitness and sagacity for physical inquiries.

ric. More recently there is the somewhat similar, but more elaborate and comprehensive, atomic theory of Mr. Exley, a work which I approach with the greatest respect, for the many profound, ingenious, and philosophic views with which it abounds; and for the very numerous explanations of phenomena which he adduces in accordance with his hypothesis, and which give it a much less speculative cast than the theories previously mentioned. The laws, however, which govern the immediate action of the atoms, if such there be, are probably not scrutable to our means or faculties; and it must be doubted whether our knowledge, even of the elements of matter, is sufficiently advanced to admit of such mathematical disquisitions: the attempt at present appears to be premature, though possibly it may be ultimately successful; and, in the mean time, the experimental researches of philosophers, with Mr. Faraday at their head, will be more useful, and teem with results of greater consequence. What an important though simple fact has lately been brought to light by this gentleman, and how much of a practical character there is about it, that the chemical action of platina in certain cases depends on its being perfectly *clean*,—a circumstance which your very profound thinker, with his algebraic formulæ, would run every chance of overlooking, because it is just on the surface of things. The sagacious practitioner having his attention alive to every incident, attaches no undue importance to what is recondite, or undervalues any thing because it has not the air of being scientific or *recherche*.

I have thus endeavored to mark the peculiar deficiencies for just reasoning and original investigation, to which the mere mathematician is liable from the biassing tendency of his studies, the natural bent of his mind, and the engrossing occupation of his time. I have illustrated this position with as many instances as my limits will allow, and I have incidentally shadowed forth the true and philosophic mode of conducting inquiries into the mixed and complex affairs which surround us on every hand. In pursuing this subject, there are one or two points on which I wish to guard against misapprehension. It is not intended, then, to impugn any of the methods adopted by the mathematicians in their own science, as purely considered, however they may have differed among themselves respecting them. Still less is it intended to impugn the modes of procedure adopted in the mixed mathematics, or to complain of what has been *fitly* done herein; but rather of what has not been so done—of premature applications of the science before the phenomena of nature have been sufficiently investigated to warrant an hypothesis—of inadequate applications, from a too great sacrifice of physical considerations in deference to the exactness of science—of partial applications being assumed to be complete, or, at any rate, to be of greater pretension and value than avowedly irregular but more comprehensive modes of considering the subject,—and of such applications being put forward in lieu of, and in preference to, tentative proceedings, even when the case points to and admits of their being adopted. Neither is it intended that those observations, or mere hints, rather, concerning the true and more ample mode of philosophising, should point to the analytic more than to the synthetic method, for they refer to both; and the reference is also as much to the secret mental process as to the published and formal procedures. The former is a curious subject, of which scarcely any thing can be known, and the little we can conjecture of it must arise from a knowledge of what passes in our own minds. How intensely interesting would it be to have before us the workings of such a mind as Newton's, whilst maturing his immortal system. We have a glimpse of such things in what is told of Kepler—of his shrewd guesses, tentative methods, and ultimate success in discovering by these means the two laws of the planetary motions which bear his name; and also in what is related of the cut and weighed paper proceedings of some of the geometricians. The results, of course, appeared in systematic mood and scientific dress. The works of Newton gave evidence of certain secret and facile means, before the method of fluxions was announced or known. We have also, in the detail of the experiments which led Sir Humphry Davy to the discovery of the miners' safety lamp, an interesting instance of this mental process, at least of the general course of his thoughts. We are not to imagine that the analysis or synthesis, as brought forth to public view, is in its mental elaboration a direct and straightforward affair. Doubtless there are alternated or mingled methods of resolution and composition, of experiment, tentation, and verification, in a round of mixed proceedings; but from this seeming chaos of thought the plastic spirit of true philosophy evolves coherent forms of symmetry, of truth, and beauty. The heart of man is a secret thing; but the mind of man is yet more impenetrable. I would also wish to be understood as not contemning mathematical acquirements in the slightest degree, but as pleading for their use in opposition to their abuse, and as moderating only the overweening pretensions

of their value and importance, both in an intellectual and useful point of view, in which the *mere* mathematician is apt to indulge.

It may be expected from me that I should apologise for assuming the censor in such sort. I beg, then, in justification and corroboration of my opinions, to quote the following sentiments, which have come under my notice since the preceding observations were written—in fact, the treatise in which they appear is just published: "In mathematics we go smoothly on, neither turning to the right hand nor to the left; there is, in fact, no alternative presented to the mind—we cannot do otherwise than give our assent to what is before us. There is no weighing, no balancing of collateral evidence, or consideration of circumstances, such as often clog and impede our progress in many of the other branches of knowledge. How often do we hear mathematicians bewail the difficulties they meet with when they wander from their own folds; and how often do we hear them give utterance to the pleasing but forlorn hope of seeing all knowledge reduced to mathematical certainty and precision?"—"If we examine mathematics in an intellectual point of view, there appears to be something of a mechanical turn in the acquisition of its truths; and it is by no means evident, that to excel in mathematical investigation, the more lofty and elevated of our mental powers are required to be brought into exercise. There is a fact, besides, established by the history of philosophy in all ages and countries, which pointedly bears out this opinion, namely, that we have daily instances of persons making themselves proficients in mathematical science at a very early age; but we never find that a person becomes eminent in mental, moral, or political philosophy, till more advanced in life. This is a fact founded upon the natural course of the human mind, and clearly teaches us, that higher qualities of intellect are required to reason upon and comprehend questions on topics relating to human affairs, than are necessary in the solution of problems connected with the pure sciences."—[Blakey's System of Logic. 1834.]

There is another very important topic connected with this subject, which is, the hurtful influence which mathematical studies, or rather, which a taste for the abstract mathematical method, has had on general reasoning, and on the tone and manner in which investigations into things in general have been conducted—a taste, which, taking its origin in the mathematical predilections which succeed the downfall of the old scholastic methods, has, from the ease and convenience which it affords, for taking determinate but narrow and contracted views of things, and the flattering but fallacious assurances it fosters of clearness, decision, and certainty, infected the universal mind, and marred the philosophy of the age. The length of this article, already too extended for a single communication, precludes me from appending my observations on this topic; but they may, probably, form the subject of another letter, if you are of opinion, Mr. Editor, that such matters are not foreign to the scope and objects embraced by your highly useful and valuable miscellany.

I am, sir, yours, &c.

BENJ. CHEVERTON.

TRANSPORTATION OF PERIODICALS.—The transportation of periodicals, recommended in a late number of the Tracts and Lyceum, has not been rightly understood by the "Advocate of Science." The plan proposed that a cheap system of conveying periodicals should be adopted, to be employed by those who wish to avail themselves of it, while others, who chose a more rapid and expensive conveyance, might still take advantage of the mails. The Advocate of Science complains of the hardships of the "honorable fraternity" of printers and publishers. I complain for them too. The law of the United States provides that their manufactures shall be carried only by public lines of conveyance, at the cost of 15, 25, or 50 cents per pound. What if a law should be passed establishing a system of transportation for the articles of the tin-shop or the bake-house, and charging the same rates of freight? Would not the bakers and tinmen complain? Would not the law be deemed an intolerable grievance? Why should booksellers, printers, and publishers, alone be limited to a public system of conveyance for their manufactures and articles of sale? The system of mails was first adapted to a very different state of society from that which now exists. When it originated, there was scarcely any occasion for the conveyance of pamphlets and magazines; and so trifling was the intercourse between different parts of our country, and so expensive was it also, that the mails needed all the support that was to be derived from the transportation of periodicals. But a remarkable change has taken place; and the increase of the transportation of periodicals, both light and solid, ephemeral and annual, is now more rapid than ever; and therefore it is absurd to keep up in an institution a provision not adapted to the times.

But what will be the bearing of a cheap

transportation of printed paper upon the interests of publishers and all connected with them? It would greatly increase their business and their profits. It would operate like the removal of a duty of 25 or 50 per cent. on their manufactures. If postage makes a periodical cost four dollars that would otherwise cost but three, the fewer persons take it. The postage now induces some to take a periodical in their vicinity, when, if the cost of transportation were the same, they would take a foreign publication. But if a publisher gets subscribers in his own town and immediate vicinity, because they have their paper or magazine without postage, he fails to get many subscribers ten, or fifteen, or twenty miles distant, because they must pay the postmaster, in addition to the publisher, one half or one third the first cost of their periodical. I know, by visiting many houses in the country, that not one family in ten takes any magazine, and not more than one in five takes a newspaper. The increase of periodicals would be very great if the transportation of them were more cheap.

The Advocate of Science objects to the slow progress of cheap locomotives, "that our Monthlies, Quarterlies, and Annuals, would be months, and quarters, and years, in reaching their destination." Now, it is one objection to the present system, that such periodicals do not reach their destination *at all.* The Report of the American Bible Society, which I highly prize, I did not get one year till about twelve months after it was printed, and even after I had received the Report of the British and Foreign Bible Society of the same date. In other cases I have never got the first mentioned Report. The mail is too expensive a mode of transporting such publications. But cheap means of conveyance need not be very slow. Over a great part of the route, from one section of the Union to another, however remote, the transportation would have the rapidity of the steamboat or the railroad car, and then would be subject only to land carriage perhaps for fifty miles, to reach the remotest hamlet in the land.

I am no printer, nor editor, but cordially concur with the Advocate of Science, in his views of the intensity of the labors of such men, and of their desert of liberal patronage, while publishing works diffusing useful information and sound morality. They are a class of men who, as society advances, will grow in numbers and respectability; and nothing will conduce more to their success than those means of transportation which will give their productions regular and cheap access to every neighborhood of our country. Such means of transportation are practicable to a great extent. I will refer to a recent fact in proof of this position. A mail is now to go between New-York and Charleston by the steamboat; which, instead of lagging behind the stage at the rate of four miles an hour, will be two or three days in advance of the land mail. Now, there is no need of charging for printing paper 16 or 25 cents per pound freight, when the ordinary freight might be only one cent a pound, and when, at an office of delivery, packages might be distributed almost as cheaply as newspapers, or at most at one cent a pound. Our country is in an extraordinary manner blessed with water communication; and railroads are now rapidly intersecting the country, and will admirably facilitate such a cheap transportation as is here suggested. In such a state of things, it is eminently absurd to require by law that periodical literature shall be carried over hills and dragged through mud at an excessive cost, merely to secure a speed for which there is no occasion and no desire.

The system of transportation for packages extended over the whole Union, like the present mail system, would in various ways accommodate the community, promote the diffusion of knowledge, and bind together our common country. F. F.—[Scientific Tracts and Lyceum.]

Improved Apparatus for removing Stone from the Bladder. [From the United States Telegraph.]

I have invented an apparatus for removing the stone from the bladder, without cutting, or scarcely paining the patient. Should you be desirous of seeing my contrivance, I shall have much pleasure in submitting it to your inspection, and explaining the manner of using it. You will see by the apparatus, that I can with the greatest facility, and without any painful sensation to the patient, apply the power of a hundred pounds weight, (and upwards if necessary,) to the body of the stone, for cutting and crumbling it in the bladder. At the same time that I apply this power to the stone, (without withdrawing the apparatus,) I inject into the bladder a fluid that facilitates the *crumbling* of the stone.

With a power much less than what I have stated, I have ascertained that my apparatus will cut and crumble a stone of two inches and a half in its longitudinal diameter, and one inch and a half in its transverse diameter, and this a stone of a harder substance than that of any formed in the bladder, and

in a moistened and comparatively softer state there than when removed from that organ, and dry. A pleasing and interesting peculiarity in a little instrument I have invented, (called a Sound,) for ascertaining if there be a stone in the bladder, is, that if it detects the presence of one, it indicates to me the diameter of it. An interesting little *tell-tale* this, you will perceive it to be, on viewing the apparatus collectively. The *power* I apply to the stone in the bladder for *cutting* it there, or for crumbling it there, is just what I might choose to exert. I can render it with precise accuracy equivalent to any weight, from one pound to a *hundred and upwards*, or retain its action at any intermediate power.

Many other interesting and important particulars connected with the use of my apparatus I must defer an explanation of until you favor me with an interview, then you will have an opportunity of verifying, by ocular observation, what I have stated. I cannot, however, forbear remarking at present, that you will perceive by the apparatus I shall not require any other assistant in performing the operation than the patient himself; and we will not doubt that he would cheerfully assist me in removing from his bladder, (without cutting or scarcely paining him,) a stone that might have been nearly half as big as his fist.

I am, sir, your obedient humble servant,

JAMES LEE HANNAH, M. D.

MODE OF PURIFYING PALM OIL.—*To purify Palm Oil, and to whiten it comparatively for making soap.* Take two parts of quick lime and three parts of the muriate of ammonia, the lime having been previously slacked with half its weight of water, and allowed to cool and reduced to a fine powder, and the muriate of ammonia having also been reduced to a fine powder, and then intimately blended with the powdered lime. The mixture is to be put into a still, or cast iron pan, having a close cover to it, and a tube leading from the head of the pan, or still, to near the bottom of the soap copper, which should contain equal quantities of water and palm oil. On fire being applied to the still, the ammoniacal gas will pass over into the soap copper; and as the water and oil combine, continue adding boiling water to the extent of treble the weight of palm oil in all. By this process the color of the palm oil will be almost instantaneously changed to a pale yellow. The boiling palm oil and water should, of course, be kept rapidly stirring while the gas is passing through. The ammonia, being an alkali, adds to the strength and detergency of the soap, while the peculiar smell imparted by it is so weak as scarcely to be susceptible after a few days' exposure to the atmosphere. —[London Mech. Mag.]

On the Location of Railroad Curvatures; being an Investigation of all the Principal Formulas which are required for Field Operations, in laying Curves and Tangent Lines, to pass through Given Points. By J. S. VAN DE GRAAFF. [From the American Railroad Journal.]

(Continued from page 175.)

14. Let the modulus of curvature be given from which a circular arc is traced in the field with a given chain; it is then proposed to determine the radius of the arc described.

It is very obvious that when n is made variable in (VII.), the *maximum* value of x will express the required radius; but when x is a *maximum*, it follows that Sin. $2n$T must be a maximum also, if it be supposed that Sin. T remains constant. Now, the quantity Sin. $2n$T obtains its *maximum* value when $2n$T $= 90°$; in which case Sin. $2n$T $= 1$. Hence, denoting the radius of the described circle, *in chains*, by R, the result is,

$$R = \frac{1}{2 \text{ Sin. } T}. \qquad \text{(VIII.)}$$

The most simple formula which can possibly be obtained to express the radius of curvature may be had by means of the cosecant of the angle T. For by the principles of trigonometry, Cosec. $T = \frac{1}{\text{Sin. } T}$; and consequently (VIII.) becomes,

$$R = \frac{1}{2} \text{ Cosec. } T. \qquad \text{(IX.)}$$

To save the trouble of computation, the following table is here subjoined:

T	R	T	R	T	R
0°. 3′	572.96	1°. 3′	27.28	2°. 3′	13.98
6′	286.48	6′	26.05	6′	13.65
9′	190.99	9′	24.91	9′	13.33
12′	143.24	12′	23.88	12′	13.03
15′	114.59	15′	22.92	15′	12.74
18′	95.49	18′	22.04	18′	12.46
21′	81.85	21′	21.22	21′	12.19
24′	71.62	24′	20.47	24′	11.94
27′	63.66	27′	19.76	27′	11.70
30′	57.30	30′	19.10	30′	11.46
33′	52.09	33′	18.49	33′	11.24
36′	47.75	36′	17.91	36′	11.02
39′	44.07	39′	17.37	39′	10.81
42′	40.93	42′	16.85	42′	10.61
45′	38.20	45′	16.37	45′	10.42
48′	35.81	48′	15.92	48′	10.24
51′	33.70	51′	15.49	51′	10.06
54′	31.83	54′	15.08	54′	9.88
57′	30.16	57′	14.69	57′	9.72
1°. 0′	28.65	2°. 0′	14.33	3°. 0′	9.55

For an application of the above table to an example, suppose it be required to determine

the radius corresponding to a modulus of curvature of 1°, as in the last numerical example. Looking in the column marked R, and opposite to 1° in the column marked T, I find 28.65, which is therefore the radius in chains; and if the modulus of curvature, 1°, appertains to a chain whose length is 100 feet, then the radius of the arc described will be 2865 feet. But if the modulus of curvature, 1°, has reference to a chain whose length is only 50 feet, then the curve traced will have a radius of only the half of 2865 feet.

15. It appears from (VIII.) that the radius of curvature is directly as the length of the chain, and inversely as the sine of the modulus of curvature. Hence, if the radius of curvature be given, then the length of the chain will be directly proportional to the sine of the modulus of curvature. If therefore a curve be traced from a given modulus T, and with a chain whose length is unity, and it be required to find what modulus will trace the same curve with a *chord* whose length in chains is p, let the required modulus be denoted by T′, and we have the proportion $1 : p :: \text{Sin. } T : \text{Sin. } T'$; from which is obtained the formula,

$$\text{Sin. } T' = p \times \text{Sin. } T. \qquad \text{(X.)}$$

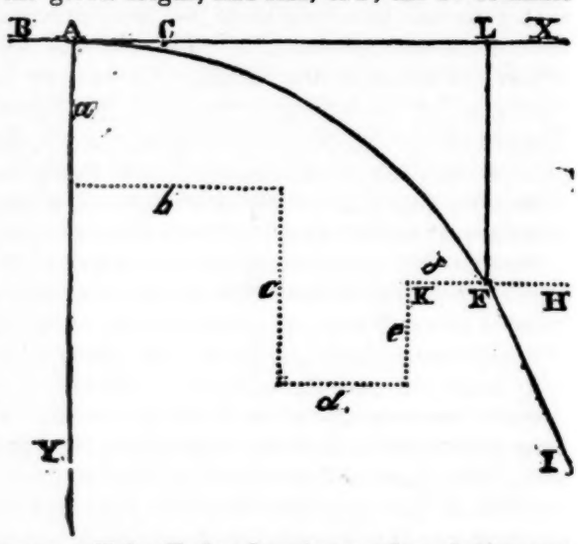
Example. Suppose the length of the chain to be 100 feet, and let it be required to determine the modulus of curvature which will trace a curve whose radius is 10743 feet, by taking chords whose lengths are 10 chains each. Here the radius of curvature is 107.43 chains; and by inspecting the table of radii, given in the last article, I find that the radius 107.43 is situated between the moduli, 0° 15′, and 0° 18′; and therefore, by proportional parts, I find the true modulus which corresponds to the radius 107.43 to be 0° 16′, and which would, consequently, trace the proposed curve with the given chain.

Hence, $\text{Sin. } T' = 10 \times \text{Sin. } 0° 16' = 10 \times .00465 = .0465$; and by the table of natural sines, I therefore find $T' = 2° 40'$, which is the modulus required.

In all cases where the angle T′ does not exceed two or three degrees, the result obtained from (X.) will not differ, by any material quantity, from that obtained agreeably to the principle given in Article 5.

16. Take a system of rectangular co-ordinate axes, having their origin at a given station in a tangent line, from which a certain required curve is to be laid, passing through a point designated by the co-ordinates x, y; the given tangent line coinciding with the axis of x. Parallel respectively to each of the co-ordinate axes, let any number of rectangular lines be traced from the origin, and terminating in the point designated for the required curve to meet; these rectangular lines being selected in any convenient manner to pass any obstacle which may happen to occur. Let the algebraic sums of each of those rectangular lines be taken, agreeably to the axis to which they are respectively parallel. Those sums will obviously give the values of the co-ordinates x, y; and from thence it is proposed to determine a formula, expressing the value of the modulus of curvature of the required curve. And it is also required, from the same data, to determine a method by means of which the instrument may be immediately directed into the true tangent at the designated point $x\,y$.

Let AX represent the given tangent line, A the given origin, and AX, AY, the co-ordinate



axes. Take F for the given point, designated by the co-ordinates $AL = x$, and $LF = y$; and let the lines marked with the small letters, a, b, c, d, &c. denote the rectangular lines, originating at A, and terminating at F, and traced in any arbitrary manner parallel respectively to each co-ordinate axis. The algebraic sums of those lines give

$$x = b + d + f$$
$$y = a + c - e.$$

It will in all cases be more convenient to determine the values of x and y, agreeably to the method here proposed, than to trace the lines AL and LF in a direct manner, even if the latter were always practicable. Very often, however, the three, a, b, c, will be sufficient.

The values of the co-ordinates x, y, having now been determined, the next object is to find the necessary modulus of curvature which will trace a curve from the origin at A, passing the point F. For this purpose let each of the expressions (VII.) be squared,* and let the last of the two be divided by the sum of the squares; the result is,

$$\text{Sin. } T = \frac{y}{x^2 + y^2}. \qquad \text{(XI.)}$$

The formula thus obtained is remarkably simple, and convenient for use; and it may perhaps be well to observe, that the *safest* method of recording the lines a, b, c, &c., in the field, will be to take on a piece of paper the form $\left\{\begin{matrix} x = \\ y = \end{matrix}\right\}$, and then record each line in its proper equation, and with its proper *sign*, immediately as their values are determined. Example: A system of rectangular lines having been traced to a designated point,

* See note, Art. 20.

let the resulting equations be $\begin{cases} x = 20 - 2 + 4 \\ y = 8 + 3 + 1. \end{cases}$ In this case, then, $x = 22$ chains, and $y = 12$ chains, and Sin. $T = \frac{12}{484+144} = \frac{12}{628} = .01911$; and by the table of natural sines I therefore find, $T = 1° 5\frac{1}{4}'$; which modulus will trace the curve required.

But if the curve AF, as first determined by means of (XI.) should appear to be too abrupt, or if from any other cause it should be considered advisable to commence the curve from a different origin upon the tangent line AX, as for instance at B or C, and still retain the same point F, then the necessary modulus of curvature from the new origin is easily obtained from the former measurements. For taking $\propto$ to denote the distance AB or AC, the new co-ordinates will obviously be $x \pm \propto$, and y; and consequently upon the same principle as in (XI.), the required formula for the new modulus is,

$$\text{Sin. } T' = \frac{y}{\sqrt{x \pm \propto|^2 + y^2}}. \qquad \text{(XII.)}$$

If, for example, the curve last considered had been commenced 3 chains *back* upon the tangent line AX, as at the point B, then the co-ordinates would have been $x + \propto = 25$, and $y = 12$; and, therefore, Sin. $T' = \frac{12}{625 + 144} = .01561$; or, $T' = 0° 53\frac{3}{4}'$; which is the modulus required to trace a curve from the new origin at B, through the point F.

The direction of the tangent will now be considered. It is very evident that the two curves considered in the two last examples will have very different directions in passing the point F; and it is a matter of considerable importance in the field, after the rectangular lines *a*, *b*, *c*, &c., have been traced to any proposed point, to be able to examine, by the direction of the instrument, what the direction of the curve would be passing from the origin through that given point. Indeed, in different situations, a curve cannot be selected without such a datum; and if the rectangular lines, *a*, *b*, *c*, &c. were not sufficient to furnish that datum with facility, a curve would have to be actually laid upon the ground in order to judge of its fitness, even if we knew a point F through which it would pass. A formula for this purpose is however easily obtained from the rectangular lines *a*, *b*, *c*, &c. Let FI represent a tangent from the point F; there would then, evidently, be no difficulty in directing the instrument, when placed at F, into the position FI, if we knew the inclination of that tangent to the original tangent AX, at the origin. For supposing KF to be the last rectangular line traced, it will, of course, be either parallel to AX, or perpendicular to it; and in *either case* it furnishes the means of directing the instrument into the line FH, parallel to the original tangent at the origin. We have then only to deflect the angle HFI, equal to the inclination of the two tangents, when that inclination is known, and the direction of the curve at F may then be seen at once, from the position of the instrument, without that delay which would be occasioned by actually tracing a curve upon the ground, which would ultimately have to be relaid.

The result therefore is, that a formula must be investigated, expressing the inclination of the two tangents, in terms of the given co-ordinates x, y. Take D to denote the inclination required; then by (IV.), $D = 2nT$; and therefore by (VII.), $x = \frac{\text{Sin. D}}{2\text{Sin. T}'}$, and, $y = \frac{1-\text{Cos. D}}{2\text{ Sin. T}}$.

Hence $\frac{\text{Sin. D}}{x} = \frac{1-\text{Cos. D}}{y}$; or, $\frac{\text{Sin. D}}{1-\text{Cos. D}} = \frac{x}{y}$.

Now, substituting for $\frac{\text{Sin. D}}{1-\text{Cos. D}}$, its value Cot. $\frac{1}{2}$D, agreeably to the principles of trigonometry, the following formula is the result,

$$\text{Cot. } \tfrac{1}{2}D = \frac{x}{y}. \qquad \text{(XIII.)}$$

Example 1. Take the same curve which was proposed as an example for (XI.) In this case, then, the co-ordinates are $x = 22$ chains, and $y = 12$ chains; and, therefore, Cot. $\frac{1}{2}D = \frac{22}{12} = 1.83333$; or, by the table of natural cotangents, $\frac{1}{2}D = 28° 36\frac{1}{2}'$; or, $D = 57° 13'$. Hence deflect the angle HFI $= 57° 13'$, and the instrument will then indicate the true direction which the proposed curve would have in passing the point F, if traced from the origin at A, by means of the modulus of curvature before determined.

Example 2. Let the direction of the curve which was proposed as an example for (XII.) be required.

Here the co-ordinates are $x + \propto = 25$, and $y = 12$; and, therefore, Cot. $\frac{1}{2}D = \frac{25}{12} = 2.08333$. Hence, $\frac{1}{2}D = 25° 38\frac{1}{2}'$, or, $D = 51° 17'$; and consequently, in this case, deflect the angle HFI $= 51° 17'$, to obtain the direction required. This curve would therefore intersect the former, at the point F, with an angle of $5° 56'$.

In all cases where both of the angles D and T have to be found, the most convenient method will be to determine the value of D by means of (XIII.), and then compute the value of T from that of D. For by a reference to (IV.) and (VII.), the following theorem will be easily deduced,

$$\text{Sin. } T = \frac{\text{Sin. D}}{2x}. \qquad \text{(XIV.)}$$

17. It is frequently necessary that several points should be designated, through which a curve is required to pass, by means of a change of curvature at each of those points. To illustrate this case, and to show the method of operation which ought to be pursued under such circumstances, take AX, (see fig. last art.,) for the primitive tangent line, and AX, AY, for primitive co-ordinate axes, whose origin is the commencement of the required curve. Trace, parallel to those axes, a system of rectangular lines given by the equations

$$\begin{cases} x = a + b + c + \&c. \\ y = d + e + f + \&c. \end{cases},$$

and terminating at the *first designated point.* Let the instrument be then placed at that point, and directed into tangent, agreeably to the method explained very fully in the last article. Take this second tangent as the axis of x, for a new system of rectangular co-ordinate axes; and parallel to these new axes, trace a second system of rectangular lines, given by the equations $\left\{\begin{array}{l} x = a' + b' + c' + \&c. \\ y = d' + e' + f' + \&c. \end{array}\right\}$, and terminating at the *second designated point.* Let the instrument be now placed at this second point, and again directed into the proper tangent, by the same means as before. Take this third tangent as the axis of x, for a third system of rectangular co-ordinate axes; and parallel to this second new system of axes, trace a third system of rectangular lines, given by the equations $\left\{\begin{array}{l} x = a'' + b'' + c'' + \&c. \\ y = d'' + e'' + f'' + \&c. \end{array}\right\}$, and terminating at the *third designated point.* Continue this obvious order of proceeding until all equations $\left\{\begin{array}{l} x = \\ y = \end{array}\right\}$ have been obtained for *all the designated points;* and then by means of those equations, and (XIV.), compute all the moduli of curvatures. Returning now with the instrument to the primitive origin at A, let each curve be traced from its proper modulus of curvature, agreeably to the principles explained in Art. 9; and the line will be found to pass through all the designated points.

If proper care be observed in chaining the different systems of rectangular lines by means of which the equations $\left\{\begin{array}{l} x = \\ y = \end{array}\right\}$ have been obtained, there can be no disappointment in the result; and consequently, if the designated points have been judiciously selected, there will very seldom be a necessity of tracing the same part of a line *the second time.* And thus the method of co-ordinate axes, in the hands of an individual to whom that term is familiar, is susceptible of being made one of the most important facilities in the field, as will be further illustrated in subsequent articles.

In tracing the various systems of rectangular lines through the different points which may be designated for a curve, there is a principle of practical convenience which must be here mentioned. I mean the principle of designating such points, for a change of curvature, as will cause each section of the whole curve, between the designated points, to be composed of an *integer number of chains,* when those curves come to be ultimately traced, after their respective moduli of curvatures have been ascertained by the methods which have been already explained. It is indeed necessary, in every case, except where the roadway is perfectly horizontal, to know the length of each of those separate curves, in order to select the designated point judiciously with respect to the *grade*; and this datum must therefore always accompany the levels. When a system of those rectangular lines have been traced to any given point, and the corresponding equations $\left\{\begin{array}{l} x = \\ y = \end{array}\right\}$ have been thus obtained, the distance from the origin to that given point, in a right line, will obviously be truly expressed by $\sqrt{x^2+y^2}$; which is a formula rendered very convenient for use, by means of the table of squares and square roots of numbers, subjoined to this volume. And this quantity may be frequently taken as the length of the intervening curve, by which to compute what the *grade* would be at that given point, and will always furnish an easy method of obtaining the approximate distance necessary in making a proper selection for the *position* of a line as far as the *levels have an influence.* The next object then must be, finally, to designate such a point as near the point fixed by the levels as a desirable curvature will permit, and which will produce a curve, from the origin, containing an *integer* number of chains; but as this last condition is only for convenience in subsequently tracing the curve, it must be done without injury to the line, which is in fact always practicable.

Suppose the first system of rectangular lines to be *terminated* at the first point selected from the nature of the ground. Let $\left\{\begin{array}{l} X = a + b + c \\ Y = d + e + f \end{array}\right\}$ be the resulting equations, and compute the value of T, and the value of a certain angle D″, from the following formulas,

$$\text{Cot. } \tfrac{1}{2} D'' = \frac{X}{Y}$$

$$\text{Sin. } T = \frac{\text{Sin. } D''}{2X} \cdot \quad \text{(XV.)}$$

Having now obtained the values of D″ and T, let a certain quantity, N, be found from the following expression,

$$N = \frac{D''}{2T} \cdot \quad \text{(XVI.)}$$

If, then, N be an integer number, it will express the number of chains in a curve passing from the origin to the point designated by the equations $\left\{\begin{array}{l} X = a + b + c \\ Y = d + e + f \end{array}\right\}$, and the angle D″ will then give the inclination of the new tangent at that point, agreeably to (XIII.); and T will express the modulus of curvature as appears from (XIV.). But if N is not an integer number, take n, the *nearest integer number to it,* and retaining the value of T, compute the corresponding *new co-ordinates* x, y, by means of (VII.)

Finally, let two other rectangular lines $h = x - X$, and $k = y - Y$, be traced from the point producing the equations $\left\{\begin{array}{l} X = a + b + c \\ Y = d + e + f \end{array}\right\}$, and a new point $\left\{\begin{array}{l} x = a + b + c + h \\ y = d + e + f + k \end{array}\right\}$ will be thus obtained, *to which* a curve being traced from the origin, by means of the modulus of curvature T, it will contain the integer number of chains denoted by n.

A Steam Waggon has been built in Massachusetts, to run on common roads. Several trials have proved its efficacy. They intend to endeavor to make it pack and unpack all its packages, and keep its own account of freight.

MANUFACTURES OF IRELAND.—The history of the manufactures of this country is in part a recital of its wrongs. The nature of the soil and climate is in favor of pastoral pursuits. This, in connection with some early restrictive measures, has prevented Ireland from ever extending its manufactures much beyond the wants of the population. As early as the reign of Edward III. a brisk trade was carried on with Italy in woollens, particularly in the Irish caddow, or woollen coverlet. A colony of the Palatines, in the reign of James I., formed their chief settlement at Carrick on Suir, and gave a stimulus to the manufacturing interest, and afforded employment for a large number of the surrounding inhabitants. Even after the prostrating wars of 1641 and 1688, the woollen trade was so flourishing that the jealousy of the British manufacturers was excited to so high a degree, that they procured an address from both houses of Parliament to William III., "to use his utmost diligence to hinder the exportation of woollens from Ireland, except to England, and generally to discourage the woollen manufacture in Ireland." Acts were passed in accordance with this petition. In 1779, however, the prohibition against exporting woollen cloths was repealed, and the trade revived. In 1812 the woollen cloth imported from England amounted in quantity to one third, and in value more than one half of all that was consumed. An existing duty of 8½d. per yard, on all qualities, served as a prohibition of the coarser kinds; and hence the reason why Irish manufactures are confined principally to low priced goods. In 1823 the protecting duties were unexpectedly repealed. This was followed by a great influx of English goods of a newer fashion, and an almost total ruin of Irish manufactures. Those dependent on the factories were reduced to depend on charity, or compelled to emigrate. Most of the woollen manufactories now existing are in the vicinity of Dublin. These produce goods to the amount of £200,000 annually.

The linen manufacture arose in part on the ruins of the woollens. In early times, the Irish gentry were profuse in the quantity of linen used in their inner garments: a shirt of a man of rank contained twenty or thirty yards. Great exertions were made by patriotic individuals to improve this branch of Irish industry, particularly by the Earl of Stafford, who, when Lord Lieutenant, embarked £30,000 of his own fortune, and by the Duke of Ormond. Since their days, the trade has been encouraged by legislative enactments. Among the expedients adopted to promote this manufacture, when in its infancy, the use of linen scarfs and hat bands at funerals was introduced.

Notwithstanding great exertion, Ireland is unable to raise its own flax-seed. That which is produced is of an inferior quality. In 1821 there were imported from

America, - - -	36,176	hhds.
Prussia, - - -	8,424	"
Holland, - - -	7,308	"
Britain, - - -	5,934	"
	57,842	hhds.

On the revocation of the edict of Nantes, the silk manufacture of Ireland had its origin. Extensive trade was carried on in worsted and mixed silk, but the fluctuation of female fashion caused a decline; and now the silk trade in Ireland is comparatively very limited. In 1825 the Earl of Liverpool, then prime minister, made great exertions to rear the silk worm in the south of Ireland, but the climate was found too chilly and moist. In 1784 the first cotton factory was erected in the neighborhood of Belfast. This trade has been fostered by government, and has increased, while the linen manufacture has necessarily declined. The manufacture of metals is limited, owing to the scarcity of fuel; but that of ardent spirits flourished in spite of severe enactments against illicit distillation. In ten years, ending in 1818, there were 16,244 unlicensed distilleries destroyed, in which 36,965 gallons of spirits, and 47,843 barrels of malt, were seized and destroyed. In the subsequent ten years, there were 41,645 distilleries, 47,843 gallons of spirits, and 156,636 barrels of malt, destroyed. Nothing but the temperance principle has made any material reduction in the use and manufacture of this injurious article.—[N. Y. Farmer.]

STEAM COMMUNICATION WITH INDIA.—The House of Commons' Committee on Steam Communication with India have reported to the House that, in their opinion, the route by the Euphrates and the Persian Gulf is superior to every other proposed, for its "physical, commercial, and political advantages," and they recommend that a grant of £20,000, should be made by Parliament to defray the expense of giving it a fair trial. The distance from Bir, in the Persian Gulf, where this line would commence, to Scanderoon, in the Mediterranean, is stated to be much less than that between Suez and Alexandria. The Committee do not appear to have inquired at all into the merits of the route by the Cape of Good Hope. We are surprised at this, for whatever may be said in favor of either of the Mediterranean routes, as affording a quick, though not always sure, conveyance for letters, we think it is demonstrable that for goods, passengers and troops, the line by the Cape is that on which steam may be employed with the greatest advantage. We alluded some time ago to a pamphlet, by the Messrs. Seward, C. E., in which this view of the subject is very ably advocated, and shall take an early opportunity of bringing it again more particularly under the attention of our readers.—[Lond. Mech. Mag.]

M. DUPIN has been so well pleased with his reception in England, that one of his colleagues, the Duke de Broglio, is about to follow his example, by paying his respects to the Lord Chancellor. Forthwith, of course, he will be taken to the Mechanics' Institution, and made an honorary member. The distinction will not, however, be so appropriately conferred as it was on M. Dupin, whose brother, Baron Chas. Dupin, is well known as the introducer of similar institutions into France.—[Ib.]

THE BLIND MAN'S BIBLE.—We have before us, in a goodly sized quarto volume, the Gospel of St. Mark, printed, or rather embossed, for the use of the blind. This is the first book that has been prepared in this country on this plan. It is the handy work of Mr. SNYDER, the gentleman who acts as secretary of the institution, and is a beautiful illustration, if no fulfilment, of the prophecy, that "the blind shall see." This admirable specimen of the art of embossing letters is worthy the attention of the curious. —[United States Gazette.]

IRON BOAT ON A NEW PRINCIPLE.—Mr. David Napier, engineer, has fitted up an iron boat on a new principle, to sail on the Clyde. A large portion of the boat below the water line is formed into a condenser, and the water outside keeps it cool, so that little (if any) injection water is required. In this plan, the water pumped into the boiler will not be so salt as if more water were let into the condenser; and an air pump a little smaller than ordinary will work the engine.—[James Whitelaw, Glasgow, June 25.]

NEW LOCOMOTIVE ENGINE.—A new locomotive engine, from the foundry of Messrs. Geo. Forrest & Co., was tried on Monday on the railway. It made the journey from Liverpool to Manchester in 67 minutes, and brought back the first class train in 77 minutes. This powerful and rapid engine is intended for the Dublin and Kingstown Railway.—[Liverpool Chronicle, July 28.]

NEW METHOD OF LIGHTING THEATRES.—A new method of diffusing light through a theatre has been discovered by a mechanist at Venice. By the aid of parabolic mirrors the light of many lamps is concentrated over an opening made in the ceiling of the theatre, and reflected downwards on a system of plano-concave lenses of a foot in diameter, which occupy the aperture, and convey into the theatre the rays of light which arrive at them parallel and depart from them divergent. From the pit the lenses are alone perceived, which resemble a glowing furnace; and although the luminous focus is sufficient to light the whole of the theatre, it does not dazzle, and may be viewed without fatiguing the eyes. The apparatus being entirely concealed, accommodates itself readily to all the changes which the representation can require. It likewise occasions neither smoke nor bad odors, and has none of the inconveniences of the old system.—[Morning Post, England.]

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This work is clearly and beautifully printed, as well as correctly, and the paper most excellent. So much for its external and internal appearance has been done, and that so well, that we were fearful the contents might not be in keeping, but on perusal thereof we were more than agreeably disappointed; we were right well pleased. There is a mild gentlemanly tone of criticism, (the suaviter in modo, and yet the fertitor in re,) which pervades through its pages; and we are glad to find that the work contains so many reviews, and with such ample extracts. There are very full and able reviews in this number of Guy Rivers, Tutti Frutti, Historical and Descriptive Account of British India, from the most remote period to the present time, Things as they are, and Tales and Sketches such as they are, and short reviews of six other popular works. The review on Foreign Politics is written in a clear and comprehensive manner, which gives good promise of its future quality, as it is to form a continuing standing feature of the Gazette. From the scourge which has visited our city, but which is now nearly abated, the proceedings of the scientific, the galleries of art, the sounds of harmony, and the places of public amusement, being suspended for a time, the editor has been prevented in this number from gratifying his readers with an account thereof. We have no doubt it will be an additional charm to the work, for science, the fine arts, and harmony, afford us the greatest and most intellectual treats, gratifying the mind, the eye, and the ear.

We trust that the expectations of the proprietors, which they have in a well written neat address on the back of the work, will not be disappointed, but that we shall for many years have the weekly pleasure of reading this really very excellent and amusing work. We see no reason why it should not last as long as its prototype, the London Literary Gazette, which has been now published for sixteen years.

THE *Mechanics' Magazine and Register of Inventions and Improvements* is published by the Proprietors, D. K. MINOR and J. E. CHALLIS, at No. 35 Wall street, New-York: in *weekly* sheets of 16 pages, at 6¼ cents—in monthly parts of 64 pages, at 25 cents—in volumes of 384 pages, in cloth boards, at $1.75—or at $3 per annum, *in advance*.—JOHN KNIGHT, (formerly proprietor of the London Mechanics' Magazine,) Editor.